

## Apparatus and Method for Angle Rotation

### *Abstract*

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An angle rotator performs angle rotation of an input complex signal in the complex plane according to an angle  $\theta$ . The angle rotator includes a coarse stage rotation and a fine stage rotation. The two specific amounts of rotation are obtained directly from the original angle, without performing iterations as are performed by known CORDIC-type methods. The coarse stage rotation is performed using truncated approximations for the cosine  $\theta_M$  and the sine  $\theta_M$ , where  $\theta_M$  is a radian angle that corresponds to a most significant word (MSW) of the input angle  $\theta$ . The fine stage rotation is performed using one or more error values that compensate for approximations and quantization errors associated with the coarse stage rotation. By partitioning the rotation into coarse and fine rotation stages, a two stage structure is obtained that requires much less hardware than a single-stage rotator, without sacrificing angle precision. This can occur because the two-stage rotator stores pre-computed cosine  $\theta_M$  and the sine  $\theta_M$  values in a small lookup table (e.g. memory device) for fast retrieval. Furthermore, the angle rotator consolidates all operations into a small number of reduced-size multipliers, enabling the use of efficient multiplier implementations, such as Booth encoding, thereby yielding a smaller and faster overall circuit. When higher precision is desired, more accurate results can be attained simply by increasing the wordlength and the multiplier size, without significantly increasing overall circuit latency.

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